

AMENDMENTSIn the ClaimsCurrent Status of Claims

- 1.(canceled)
- 2.(canceled)
- 3.(canceled)
- 4.(canceled)
- 5.(canceled)
- 6.(canceled)
- 7.(canceled)
- 8.(canceled)
- 9.(canceled)

1 10.(currently amended) An analytical instrument including an excitation source for producing
2 an incident waveform, a detector for receiving either a transmission spectrum or a reflectance
3 spectrum or both a transmission spectrum and a reflectance spectrum of an object or volume of
4 interest, and a processing unit for analyzing the spectra, where the processing unit includes software
5 encoding the inverse scattering method of Claims 4-914, 15, 16, 17, 18, 19, 20, or 21.

1 11.(currently amended) A sonic analytical instrument including a sonic excitation source for
2 producing an incident sonic waveform, a detector for receiving either a sonic transmission spectrum
3 or a sonic reflectance spectrum or both a sonic transmission spectrum and a sonic reflectance
4 spectrum of an object or volume of interest, and a processing unit for analyzing the sonic spectra,
5 where the processing unit includes software encoding the inverse scattering method of Claims 1-914,
6 15, 16, 17, 18, 19, 20, or 21.

1 12.(currently amended) An electromagnetic analytical instrument including an electromagnetic
2 excitation source for producing an incident electromagnetic waveform, a detector for receiving
3 either an electromagnetic transmission spectrum or an electromagnetic reflectance spectrum or both
4 an electromagnetic transmission spectrum and an electromagnetic reflectance spectrum of an object
5 or volume of interest, and a processing unit for analyzing the electromagnetic spectra, where the
6 processing unit includes software encoding the inverse scattering method of claims 1-914, 15, 16,

7 17, 18, 19, 20, or 21.

1 13.(currently amended) An analytical instrument including a sonic excitation source and an
 2 electromagnetic excitation source for producing an incident sonic waveform and an incident
 3 electromagnetic waveform, a detector for receiving either a sonic transmission spectrum or a sonic
 4 reflectance spectrum or both a sonic transmission spectrum and a sonic reflectance spectrum of an
 5 object or volume of interest, a detector for receiving either an electromagnetic transmission
 6 spectrum or an electromagnetic reflectance spectrum or both an electromagnetic transmission
 7 spectrum and an electromagnetic reflectance spectrum of an object or volume of interest, and a
 8 processing unit for analyzing the sonic and electromagnetic spectra, where the processing unit
 9 includes software encoding the inverse scattering method of Claims 1-914, 15, 16, 17, 18, 19, 20,
 10 or 21.

1 14.(new) A method for analyzing inverse scattering spectral components comprising the steps
 2 of:
 3 irradiating an object with a measuring wave;
 4 measuring a reflection spectrum of the object;
 5 measuring a transmission spectrum of the object;
 6 calculating a transmission coefficient on a computer from:

$$7 \quad t_k = 1 - \frac{ik}{2} \int_{-\infty}^{+\infty} dz e^{ikz} V(z) \psi_k^+(z),$$

8 where $V(z)$ is the location interaction between the object and $\psi_k^+(z)$ is the measuring
 9 wave,

10 calculating a reflection coefficient on the computer from:

$$11 \quad r_k = - \frac{ik}{2} \int_{-\infty}^{+\infty} e^{-ikz} V(z) \psi_k^+(z)$$

12 using a set of definitions

$$13 \quad t_k \tilde{\psi}_k(z) = \psi_k^+(z)$$

$$14 \quad \frac{r_k}{t_k} = \tilde{r}_k$$

15
$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) \frac{2i}{k} \tilde{r}_k e^{-2ikz}$$

16 to convert a Lippmann-Schwinger inverse scattering equation

17
$$\psi_k^+(z) = e^{ikz} - \frac{ik}{2} \int_{-\infty}^{+\infty} dz' e^{ik|z-z'|} V(z') \psi_k^+(z')$$

18 on the computer into a Volterra-type form

19
$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) e^{-2ikz} \frac{2i}{k} r_k \left[1 + \frac{ik}{2} \int_{-\infty}^{+\infty} e^{-2ikz_j} V(z_j) \tilde{\psi}_k(z) \right]; \text{ and}$$

20 iterating the Volterra-type form of the Lippman-Schwinger equation on the computer to
21 produce an approximate solution $\tilde{V}_1(z)$, where $\tilde{V}_1(z)$ is absolutely and uniformly convergent.

1 15.(new) The method of claim 14, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 four terms.

1 16.(new) The method of claim 14, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 three terms.

1 17.(new) The method of claim 14, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 two terms.

18.(new) A method for analyzing inverse scattering components of a spectrum of an object of
interest comprising the steps of:

obtaining a reflectance and/or transmission spectra of an object of interest using an incident
waveform from the group consisting of an electromagnetic waveform, sonic waveform and mixtures
or combinations thereof;

calculating a transmission coefficient on a computer from:

$$t_k = 1 - \frac{ik}{2} \int_{-\infty}^{+\infty} dz e^{ikz} V(z) \psi_k^+(z),$$

where $V(z)$ is the location interaction between the object and $\psi_k^+(z)$ is the measuring

wave,

calculating a reflection coefficient on the computer from:

$$r_k = -\frac{ik}{2} \int_{-\infty}^{+\infty} e^{-ikz} V(z) \psi_k^+(z)$$

using a set of definitions

$$t_k \tilde{\psi}_k(z) = \psi_k^+(z)$$

$$\frac{r_k}{t_k} = \tilde{r}_k$$

$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) \frac{2i}{k} \tilde{r}_k e^{-2ikz}$$

to convert a Lippmann-Schwinger inverse scattering equation

$$\psi_k^+(z) = e^{ikz} - \frac{ik}{2} \int_{-\infty}^{+\infty} dz' e^{ik|z-z'|} V(z') \psi_k^+(z')$$

on the computer into a Volterra-type form

$$\tilde{V}_1(z) = \int_{-\infty}^{+\infty} d(2k) e^{-2ikz} \frac{2i}{k} r_k \left[1 + \frac{ik}{2} \int_{-\infty}^{+\infty} e^{-ikz} V(z_j) \tilde{\psi}_k(z_j) \right]; \text{ and}$$

iterating the Volterra-type form of the Lippman-Schwinger equation on the computer to produce $\tilde{V}_1(z)$, where $\tilde{V}_1(z)$ is absolutely and uniformly convergent.

1 19.(new) The method of claim 18, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 four terms.

1 20.(new) The method of claim 18, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 three terms.

1 21.(new) The method of claim 18, wherein the approximate solution includes $\tilde{V}_1(z)$ includes
2 two terms.